FOOD OF THE MUDFISH (AMIA CALVA) IN LAKE NEWNAN, FLORIDA, IN RELATION TO ITS MANAGEMENT [1]

Frederick H. Berry
University of Florida

My study of the mudfish, or bowfin (*Amia calva*), was begun in an attempt to determine if this species effected any appreciable control on the tremendous and presumably undesirable population of gizzard shad (*Dorosoma cepedianum*) in Lake Newnan. The scarcity of information on the food habits of mudfish suggested that the observations be extended. The carnivorous nature of the species has been long recognized. While Schneberger (1937) concluded that the young (under three inches in length) had not become piscivorous, others have shown that fish comprise the majority of the diet. Miles (1912) declared that the mudfish lives on the same food as the largemouth black bass. Forbes and Richardson (1920) stated that a third of the "entirely animal food" of the stomachs they examined was fish. Scott (1938) found that over half of the stomachs he examined contained fish. Studies by Lagler and Hubbs (1940) and Lagler and Applegate (1942) showed approximately the same results.

Lake Newnan is situated four miles east of Gainesville, Alachua County, Florida. It receives surface runoff mainly from Hatchett Creek and several smaller creeks to the north and from hardwood swamps and pine flatwoods to the east, north, and west. The permanent outlet is through Prairie Creek to the south. Camp's Canal diverts the outflow through the River Styx into the Orange Lake-Orange Creek-Oklawaha River-St. Johns River drainage system. The kidney shaped lake basin covers nearly 6,200 acres and has a shore line of about eleven miles. Water level fluctuates about three feet from dry to rainy seasons. In a gradual slope from the shore the water attains a maximum depth of about twelve feet near the middle of the lake during the drier months. The average depth during this period is estimated to be four feet. The basin of claey-sand is exposed in wave washed areas near the shore; but it is mostly covered by a layer of flocculent liver mud and fine plant debris which is over ten feet in thickness near the middle.

[1] I am indebted to Mr. Wayne Hook and other members of the Florida Game and Fresh Water Fish Commission for their assistance.

Table 1.—Food of the Mudfish.

Date 1954	No. of Stomachs Containing Each Type Food				No. of Stomachs Empty	No. of Stomachs Containing a Single Type or Combination of Types of Food								No. of Stomachs Containing Food	No. of Stomachs Examined
	Speckled Perch	Catfish	Fish Remains	Miscellaneous		Speckled Perch & Crayfish	Speckled Perch Only	Speckled Perch & Fish Remains	Speckled Perch, Catfish & Fish Rem.	Catfish & Fish Remains	Catfish Only	Fish Remains	Scales	Miscellaneous		
March	7	6	10	1[a]	1	1	5	1		5	1	4			17	18
April	6	3	7		2		3	2	1	1	1	3			11	13
May	9	6	6		3		9			4	2	5	3		23	26
June	5	3	7	2[b c]	8		3	2		1	2	2		2[b c]	12	20
July		5	1	4[d]	6[e]						5	2	3	3	10	16
Nov.		4			1						4				4	5
Totals	27	27	31	7	21	1	20	5	1	11	15	16	6	2	77	98.

a, Crayfish
b, Gizzard
c, Clam Shell Remains
d, Scales Only
e, Trot Line Hook

The brownish, turbid water is frequently tinted green by the abundant phytoplankton. Zooplankters are also abundant.

The lake is bordered by baldcypress (*Taxodium distichum*). Other than filiamentous algae, only a few scattered submerged aquatic plants and emergent aquatics occur in the lake. Finely branched submerged roots of the cypress trees appear to serve as a habitat for many of the smaller animals in the absence of other vegetation. The shore mats and floating rafts of water hyacinths (*Piaropus crassipes*) that once covered large portions of the lake have been greatly reduced. Two duckweeds (*Lemna minor* and *Spirodela polyrhiza*) are found inshore in association with the hyacinths.

Twenty-one species of fish have been collected in the lake, and five additional species have been recorded from the mouths of the creeks.

Methods and Equipment

The mudfish were obtained from the seining activities in Lake Newnan in concurrence with the rough fish removal program of the Florida Game and Fresh Water Fish Commission. After laying out the 1,600 yard haul seine, approximately three hours were required to complete the haul and to dip-net the fish from the enclosed pocket. The stomachs were placed in 10% formalin soon after the fish were weighed and measured. Early in the study, identification of the contents and relative degrees of digestion only were recorded. Later, volumetric measurements and length reconstructions of the contents were taken for further analyses. Records of the catch of the haul seine and of collections made with an otter trawl and a 40 foot bag seine were used to estimate the numbers and size ranges of other species in the lake related to this study. The stomachs of three mudfish, that had been force-fed living fish, were examined three hours after feeding in an attempt to obtain some idea of the rate and extent of digestion.

Results

From March 2, 1954, through November 7, 1954, 98 specimens were obtained from 23 seine hauls. Of the 77 with particulate contents, 75 contained fish or fish remains. Of the two with non-fish contents: one contained parts of a clam shell (*Anodonta* sp.); the other, a bird-like gizzard. One stomach containing fish also contained two crayfish (*Procambarus* sp.). Several days after the

capture of this fish, the lake was sprayed with 2-4-D to destroy the water hyacinths. Seining with the small mesh bag seine showed a subsequent scarcity of crayfish from most areas of the lake shore. This observation is included because crayfish were found in abundance in mudfish stomachs in other studies (Forbes and Richardson, Scott, Lagler and Hubbs, Lagler and Applegate). My examination of the stomachs of one specimen taken from Silver Springs, Florida, and one from Orange Lake, Florida, revealed crayfish remains. Apparently this item is utilized as food when it is available. The previously cited studies also reported the following as food items: frogs, snails, clams, insects, leeches, earthworms, and carrion. Generally, these miscellaneous records were few in frequency of occurrence and in volumetric composition.

Fish that were found in the stomachs were of three types: 1) speckled perch, or black crappie (*Pomoxis nigromaculatus*), 2) catfish (one *Ictalurus catus* and several *Ameiurus nebulosus* were identified), and 3) unidentifiable fish remains. The two identifiable species, speckled perch and catfish, were found together in only one stomach. The speckled perch were more common from the March collections to early June, when the catfish became more numerous. This apparent trend does not correlate with changes in size or number of the two types in the lake. Collections with the otter trawl and bag seine yielded relatively constant numbers and sizes of both speckled perch and catfish. Reconstructions of the total lengths of ingested speckled perch furnished a size range of about 4 to 8 inches; of catfish, 2.5 to 6.5 inches. Each of these was present in 27 of the stomachs. Collectively, the identifiable speckled perch and catfish were found in 53 of the stomachs that were not empty.

Forbes and Richardson reported minnows and buffalo fish in the stomachs of their 21 specimens. Scott listed six different identifiable genera (including catfish) from 71 stomachs; Lagler and Hubbs, 13 genera (including catfish, speckled perch, and gizzard shad) from 131 stomachs; Lagler and Applegate, 11 genera from 73 stomachs. Unpublished records of the Florida Game and Fresh Water Fish Commission of mudfish stomach analyses conducted at Lake Okeechobee show that 11 genera were found in 137 stomachs containing food (including speckled perch in 37 stomachs, catfish in 11, and gizzard shad in 28). It is my opinion that the selectivity of the diet of the mudfish in Lake Newnan,

expressed by the finding of only two identifiable species of fish in the stomachs examined, is an atypical expression of its food habits. The main causes of this selectivity are probably the lack of competition pressure among piscivorous species (suggested by population sampling) and a correlation of the activities of the speckled perch and catfish with the feeding habits of the mudfish.

The majority of authors making recommendations regarding control of the mudfish describe it as a noxious, voracious predator and suggest its removal (Forbes and Richardson, Scott, Black, 1954, Dequine, 1952, *et. al.*). It is apparent, however, that: if another species constituted a greater problem to fish management (as the gizzard shad in Lake Newnan); if the predatory habits of the mudfish effected a control upon this species; and if this control were not overbalanced through competition with desirable species, then the mudfish should not be removed. Haul seine reports for Lake Newnan from October, 1953, to October, 1954, listed the following approximate percentage composition by weight: mudfish, 0.8%; spcekled perch, 5%; gizzard shad, 84%. Although tremendous numbers of gizzard shad small enough for the mudfish to feed upon were present in the lake, none were identified from the stomachs examined. This indicates that the mudfish effects no control on the shad population; and, since it preys upon a desirable pan fish, the speckled perch, and is generally a detriment to fishing, its removal seems warranted during the course of current seining activities. The undesirable attributes of the mudfish in Lake Newnan are not excessive enough, however, to require control measures strictly in its own behalf at this time.

Lack of information on the rate of digestion of stomach contents was acknowledged as being the possible cause of misinterpretation of the results due to either of two factors: 1) since an average of three hours elapsed from the laying out of the haul seine to the dip-netting of the catch, the mudfish could presumably feed unnaturally upon the many smaller fish enclosed; 2) if digestion were rapid, stomach contents might be enormously reduced from the time of cessation of feeding to preservation. The degrees of digestion of the contents were recorded as: slight, represented by errosion of the skin of catfish and dislocation of fin rays of centrarchids, and moderate, advanced, and unidentifiable, all representing increasingly more advanced stages of digestion.

In November, three mudfish were imprisoned in a 5 x 7 ft. wire cage in the lake. After several days a live speckled perch was forced into the stomach of one, a catfish into each of the other two. The mudfish were taken from the water after three hours, and the stomachs were put in formalin. On laboratory comparison, all three fish that had been force-fed to the mudfish showed less effects of digestive action than any of the fish contained in stomachs obtained from the haul seine. This suggests that digestive action is relatively slow, at least during the first three hours after feeding, and that all fish contents taken from the stomachs of mudfish captured in the haul seine represent those taken in the course of natural feeding. The possibility that these suggestions are valid warrants further experimentation to determine seasonal, psychological, and other influencing factors.

All but three of the 102 stomachs examined (including the three caged specimens) were heavily infested with an unidentified species of tape worm. This is a higher infestation than found by Bangham (1945) in which only 15 of 21 mudfish from other Florida waters contained tapeworm. Scott reported a 20% infestation in Indiana mudfish. The three stomachs that were uninfested were empty. The intestine of one of the uninfested specimens contained a trot line hook embedded near the pylorus with twelve inches of attached line extending out through the anus.

Conclusions

Comparison of the results of this study with those of other workers show that fish comprise the major portion of the diet of the mudfish. The selectivity of its diet in Lake Newnan is evidently an atypical case, probably governed by the nature of the composition of the present fish population of the lake. Absence of gizzard shad and the presence of speckled perch in the contents show that its feeding activities do not conform to current fish management concepts; consequently, its removal is recommended. The reliability of the results obtained from the haul seine seems plausable in view of the brief experiment conducted on the rate of digestion.

Bibliography

BANGHAM, RALPH V.
1941. Parasites of fresh-water fish of Southern Florida. Proc. Fla. Acad. Sci., 5(4): 289-307.

BLACK, JOHN D.
1954. Biological Conservation. Blakiston Co., Inc., p. 138.

DEQUINE, JOHN F.
1952. Florida's controlled seining program. Fla. Game and Freshwater Fish Comm., Fish Mgmt. Bul. No. 1: 1-39.

FORBES, S. A., and R. E. RICHARDSON
1920. Fishes of Illinois. Ill. Nat. Hist. Ser., Vol. 3, Ichthyology, pp. 38-41.

LAGLER, K. F., and FRANCES V. HUBBS
1940. Food of the long-nosed gar *(Lepisosteus osseus oxyurus)* and the bowfin *(Amia calva)* in Southern Michigan. Copeia, No. 4: 239-241.

LAGLER, K. F., and V. C. APPLEGATE
1942. Further studies on the food of the bowfin *(Amia calva)* in Southern Michigan, with notes on the inadvisability of using trapped fish in food analyses. Copeia, No. 3: 190-191.

SCHNEBERGER, E.
1937. The food of small dogfish *(Amia calva)*. Copeia, No. 1: 61.

SCOTT, WILL
1938. The food of *Amia* and *Lepisosteus*. Invest. Ind. Lakes and Streams, 1(9): 110-115.